The association between dietary protein intake and depression among university students

Association between dietary protein intake and depression

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Abstract

Aim: Depression, a chronic disease, affects approximately 322 million people worldwide. The results of studies examining the relationship between depression and consumption of milk and dairy products and protein are unclear. The aim of this study was to examine the relationship between healthy university students' milk and milk products and protein intake and depression.

Material and Methods: This cross-sectional study was conducted with 1444 healthy university students aged 18-39 in Kırklareli in 2019. The data consisting of the Food Frequency Questionnaire (FFQ), Beck Depression Inventory, and anthropometric measurements were collected by dietitians.

Results: According to the results of the study, the daily dietary protein intake (g) and the energy from protein (%) differed significantly between participants with and without symptoms of depression (p <0.01). Depression scores and protein intake of participants, and energy from dietary protein (%) are inversely correlated (p<0.05, p<0.001, respectively). According to the regression analysis results, a negative association was found between the Beck depression score and the dietary protein percentage (p <0.001).

Discussion: In our study, it was concluded that increasing the amount of protein in the diet can reduce the risk of depression in healthy university students. It is necessary to pay attention to the energy of the diet from protein in places that provide food service systems (canteen, university cafeteria, dormitory cafeteria, etc.) where university students eat.

Keywords

Depression; Dietary Intake; Protein; Milk; Dairy Products

Introduction

Depression affects approximately 322 million people worldwide (WHO. Depression and other common mental disorders global health estimates. World Health Organisation. Geneva, Switzerland, 2017) . It is suggested that inflammation, oxidative stress, and intestinal microbiota all play a key role in the etiology of depression [1]. Nutrition is an effective factor in the prevention and management of depressive disorders [1]. There are many studies on the relation of milk and dairy products with depression [2-9]. In a systematic review, it was shown that the relationship between dairy consumption and depressive symptoms is contradictory and inconsistent [2]. While there are studies showing that there is no relationship between milk consumption and depressive symptoms, there are also studies that have found a significant relationship between consumption of milk and dairy products and depressive symptoms [3-7]. One study found that high yogurt consumption in women was associated with a lower risk of depression [8]. In a study evaluating the relationship between calcium intake and depression in university students, low calcium consumption was associated with insomnia and depression [9].

The results of studies on the relationship between dietary protein and depression are not clear. While some studies show that dietary protein intake is inversely related to the risk of depression, other studies have reported that this relationship is not significant [6, 10-12]. Another study showed that total protein intake and protein intake from milk and dairy products can reduce the risk of depressive symptoms in adults living in the USA [13].

Controversial results have been obtained in studies examining the relationship between depression and milk and dairy products and protein consumption. In this study, it was aimed to contribute to the literature on this subject by evaluating the relationship between the consumption of milk and dairy products and the total protein intake of university students with the risk of depression.

Material and Methods

Setting and Sample

All registered undergraduate students studying at Kırklareli University, Kırklareli central district campuses, formed the universe of the study (N = 18065). The minimum sample size was determined to be 970 with a 95% confidence interval, 50% unknown expected prevalence, 5% margin of error (α = 0.05), 3% deviation (d = 0.03), which is the method of calculating the sample size of the study in proportions. Considering possible data loss, the sample size was increased by 70% and it was targeted to reach 1650 people. The proportionate stratified sampling method was used in the study. The three campuses in the central district were stratified and the number of people from each campus to be included in the study was determined according to the population sampling rate. Considering that it may affect the findings, 9 out of 1650 students who are > 39 years old were excluded from the study. Unmarried students were included, and 23 married students were excluded. Finally, 174 individuals with any health problems among the students were excluded from the study. The study sample consists of 1444 individuals.

Ethical approval

Ethical approval was obtained from Kırklareli University Institute of Health Sciences Ethics Committee (in 2019, protocol code: P0120R00). Before participating in the study, the participants were informed about the study and their consent was obtained.

Food Frequency Questionnaire

In this survey, the frequency and amount of food consumed were questioned. The food frequency questionnaire including 5 groups of foods (milk and dairy products, meat-egg-legume, vegetable and fruit, bread and cereal, oil-sugar-sweet and drinks) was applied to participants to remember their consumption of the last month. The consumption frequency consists of 8 frequencies. The daily amount of food consumption was calculated by multiplying the total amount with the coefficients of these frequencies: each meal (3), every day (1), 1-2 times a week (0.215), 5-6 times a week (0.7855), 1 time in 15 days (0.067), 1 time per month (0.033) and never (0). The energy and nutrient intake of the individuals were calculated by entering daily food intake in the BEBIS 8.0 software (Nutrition Information System).

Depression Status

The Beck Depression Inventory (BDI), which was developed by Beck et al. and whose validity and reliability study was conducted by Tegin and Hisli, was applied to the participants. A high total score indicates that the severity of the depression is high (Tegin B. Cognitive Disorders in Depression: A review according to the Beck model. PhD thesis, Ankara, Hacettepe University Social Sciences Institute, 1980). [14, 15]. In addition, the BDI has cut-off points. According to the scores obtained, ≤9 points mean no depression and ≥10 points are classified as having depression (10-16: mild, 17-29: moderate, ≥30: severe).

Anthropometric Measurements

Body weight and height, of the individuals were taken and recorded in the questionnaire form using electronic scales sensitive to 100 grams of body weight, without shoes and thin clothes. The height was measured with a portable stadiometer without shoes and against the wall.

The BMI (kg/m2) of the individuals was calculated and classified. WHO classification was used in this process. Thirty and over are classified as obese, 25-29.9 slightly obese, 18.5-24.9 normal and <18.5 underweight [16].

Study Analysis

Analyzes were made in IBM SPSS software 24th version. Data are given as frequency (%), mean ± SD or median (33th-67th percentiles). The normality of the distribution was checked with the Kolmogorov-Smirnov test. Student's t-test, a parametric test, and the Mann-Whitney-U test, a nonparametric test were used in comparing the differences between averages. Pearson's Chi-Square Test was used to compare the differences between ratios. The relationship between continuous variables was checked with Spearman's rho correlation tests. The amount of milk consumption, yogurt consumption, cheese consumption, dairy-based dessert consumption and the predictors of depression were determined using multiple linear regression analysis. All p- values were two- tailed and were considered statistically significant at <0.05.

Results

A total of 1444 participants (52.6% men and 47.4% women) were recruited. BMI status of the participants (64.9% normal, 9.3% underweight, 25.8% overweight and obese) was determined.

It was observed that the participants with a non-depressive score and a depressive score did not differ in terms of total daily energy (kcal), meeting energy requirement (%), daily carbohydrate intake (g), energy from dietary carbohydrate (%), daily fat intake (g), energy from dietary fat (%), daily calcium intake (mg) and meeting calcium requirement (%). However, lower protein intake (g, P=0.002) and energy from dietary protein (%, p<0.001) was seen in participants with a depressive score. The rate of meeting the calcium requirement was 86.16% (Table 1).

There was no correlation between daily consumption of milk and dairy products, calcium intake and the Beck depression score (p> 0.05). There are correlations between the protein intake (p = 0.013, r = -0.065) and dietary protein percentage (p <0.001, r = -0.092) with Beck's depression score (Table 2).

In Table 3, the association between the Beck depression score and the percentage of dietary energy from protein was evaluated using linear regression analysis. In the sex-adjusted model, a statistically significant negative association was found between dietary energy from protein (% kcal) and Beck Depression score (B: -0.148, 95% CI: -0.248; -0.047).

Table 1. Distribution of descriptive and dietary characteristics of the participants according to depressive symptoms

Characteristics	Total	Non-depressive (Score: ≤9)	Depressive (Score: >9)	P value
Number of subjects (%)	1444	828 (57.3)	616 (42.7)	
Gender (%)				<0.001
Male	760 (52.6)	487 (58.8)	273 (44.3)	
Female	684 (47.4)	341 (41.2)	343 (55.7)	
Body Mass Index (BMI)				0.100
Underweight	135 (9.3)	68 (8.2)	67 (10.9)	
Normal	937 (64.9)	535 (64.6)	402 (65.2)	
Overweight	316 (21.9)	196 (23.7)	120 (19.5)	
Obesity	56 (3.9)	29 (3.5)	27 (4.4)	
Total energy intake (kcal/d) Mean±SD	2441.03±843.30	2459.82±820.91	2415.76±872.53	0.326
Meeting energy requirement (%) Mean±SD	94.64±3.26	93.85±1.10	95.71±1.37	0.282
Total carbohydrate intake (g/d) Mean±SD	281.39±115.58	281.44±112.66	281.32±119.49	0.985
Dietary energy from carbohydrates (% kcal) Mean±SD	46.52±8.27	46.21±8.30	46,94±8.21	0.097
Total protein intake (g/d) Mean±SD	88.74±37.37	91.38±37.68	85.18±36.69	0.002
Dietary energy from protein (% kcal) Mean±SD	15.02±4.02	15.37±4.11	14.54±3.84	<0.001
Total fat intake (g/d) Mean±SD	102.85±39.00	37.84±38.21	37.89±40.04	0.319
Dietary energy from fat (% kcal) Mean±SD	37.86±7.87	87.10±7.83	84.88±7.92	0.896
Total calcium intake (mg/d) Mean±SD	861.66±328.90	871.00±315.25	849.11±346.28	0.211
Meeting calcium requirement (%) Mean±SD	86.16±32.90	87.10±31.52	84.88±34.64	0.205

Table 2. Correlation between Beck Depression score and protein, daily dairy and calcium intake

	Beck Depression Score	
	r	p
Milk	−0.040	0.130
Yoghurt	0.027	0.303
Milk Dessert	0.033	0.203
Cheese	−0.036	0.174
Protein intake	−0.065*	0.013
Dietary energy from protein (% kcal)	−0.092**	<0.001
Calcium intake	−0.026	0.317
Meeting calcium requirements (%)	−0.026	0.315

*: p<0.05, **: p<0.001

Table 3. Evaluation of the relationship between Beck depression score and dietary protein percentage with linear regression analysis

Variable	Unadjusted B (95% CI)	p-value	*Adjusted B (95% CI)	p-value
Protein (% kcal)	-0.181 (-0.281;-0.080)	0.000	-0.148 (-0.248;-0.047)	0.004

*Adjusted for sex. Adj.R²: 0.023. F: 17.955. p <0.001

Discussion

In our study, it was observed that there was no statistical difference between the participants who showed and did not show symptoms of depression according to the Beck depression score in terms of dietary energy intake (kcal), energy requirement percentage (%), dietary carbohydrate intake (g), dietary carbohydrate percentage (%), dietary fat intake (g), dietary fat percentage (%), and dietary calcium intake (mg). However, the dietary protein intake (g) and dietary protein percentage (%) were found to be statistically lower in individuals with depression symptoms than in those without depression symptoms. In this study, a negative correlation was found between Beck's depression score and dietary protein amount (g) and dietary energy from protein percentage. In addition, there was no significant correlation between Beck's depression score and daily milk and dairy consumption and dietary calcium. According to the sex-adjusted regression model, a negative association was found between the Beck depression score and the dietary energy from protein.

As a result of the literature review, it is seen that the relationships between depression and milk and dairy products and calcium are not clear, and there are conflicting and inconsistent results. For example, a systematic review found that the relationship between dairy consumption and depressive symptoms was contradictory and inconsistent [2], while a study on 1319 women in Japan found that more milk consumption during pregnancy reduced postpartum depressive symptoms [3].

In a study examining the factors affecting the prevalence of depressive symptoms during pregnancy, it was concluded that yogurt and calcium intake may be associated with low depressive symptoms during pregnancy [5]. In a study conducted with 887 elderly individuals in Japan, it was observed that consumption of dairy products reduces depressive symptoms regardless of gender [4]. In a cross-sectional study involving 1000 university students in Jordan, it was found that participants with moderate

to severe insomnia had lower milk and calcium consumption and higher anxiety and depression scores compared to participants without insomnia [9]. In another study, milk and dairy products, vegetable protein and calcium intake were found to be significantly lower in Korean women with polycystic ovary syndrome (PCOS) with symptoms of depression [17]. In a cohort study, high yogurt consumption was found to be associated with a lower risk of depression in women [8]. In another study, consumption of milk-based desserts in adults was found to be negatively associated with depressive symptoms [18]. A cross-sectional study of 19,596 adults to investigate the relationship between yogurt consumption and depressive symptoms in China suggested that there was no significant relation between normal yogurt consumption level and depressive symptoms, however the relatively high frequency of yogurt consumption in a small subset of subjects (twice / day) has been associated with increased depressive symptoms [7]. In our study, the positive relationship found between the consumption of milk-based desserts and depression was not significant, but in a study conducted with Type 1 diabetics in Finland, an increase in the "dessert" score was reported to be positively associated with depressive symptoms [19].

There are studies in the literature that find an inverse relationship between dietary protein and depression scores, as in our study [10, 11, 13, 19-21]. In a study involving 17,845 adults living in the USA, using data from 2007-2014, it was concluded that protein intake could reduce the risk of depression [13]. In two cross-sectional studies conducted separately in Japanese male workers [10] and Spanish children [11], an inverse relationship was found between protein intake and depression. A cross-sectional study of 976 adults with Type 1 diabetes in Finland concluded that a preference for protein over carbohydrates and fats was associated with lower levels of depressive symptoms [19]. In the Villanueva Elderly Health Study, a negative relationship was observed between protein and depression [20]. In a study of 1947 men and 2909 women between the ages of 25-74, it was concluded that while increasing protein intake created a protective effect in men, there was a positive relationship between protein intake and severe depressive mood in women [6]. Unlike the results of our study, there are also studies that have not found a positive or any relationship between protein and depression. In a cross-sectional study conducted in Israel with 112 elderly individuals [21], it was observed that there was no difference in protein intake between depressive and non-depressive groups. In a cross-sectional study conducted in Poland [12], it was found that the relationship between protein intake and depressive symptoms was not significant. In another study, on Korean women diagnosed with PCOS, those with depression symptoms were found to have significantly higher energy intake from protein [17].

Various studies indicate that tryptophan, tyrosine, and calcium may prevent or reduce depression [18, 22, 23]. It has been confirmed that serotonin deficiency is associated with depressive symptoms [22]. Milk is a good source of tryptophan, an essential amino acid. 5-hydroxy tryptophan formed as a result of the hydroxylation of tryptophan is the precursor compound of serotonin [18, 22]. Therefore, intake of tryptophan can reduce depressive symptoms by increasing the level of serotonin in the brain [22]. In addition, milk and dairy products are a good source of tyrosine, and tyrosine has been found to affect mood as it is a precursor of dopamine [22]. Torres et al. [23] found that the decrease in extracellular Ca2+ concentration that occurs during excitatory transmission is detected by neighboring astrocytes, and adenosine triphosphate (ATP) released from astrocytic Cx43 hemi channels enhances inhibitory transmission by activating P2Y1 receptors on neurons. Higher calcium intake can attenuate extracellular Ca2+ fluctuations and hinder inhibitory transmission. This may be effective in decreasing depressive symptoms [23]. Calcium also participates in the synthesis of serotonin by activating tryptophan hydroxylase, which may reduce depressive symptoms [18].

Conclusion

In our study, it was concluded that increasing the amount of protein in the diet can reduce the risk of depression in healthy university students. However, no significant relationship was found between milk and dairy consumption and depression. Experimental studies are needed to overcome the inconsistencies in the literature.

Study Strengths

Our study was carried out on a large sample, and this increases the reliability of our study. In addition, since our study was conducted before the COVID-19 pandemic, all participants were interviewed face-to-face. Food consumption records were taken by nutrition and dietetics experts.

Study limitation

Since the food frequency questionnaire was used in our study, some mistakes may be made in the specified amounts of consumption due to incorrect recall. In order to minimize these mistakes, food consumption records were applied through a large sample by nutrition and dietetics specialists. In addition, due to the survey not only of milk and dairy products, but also all food groups, dairy products with different compositions (semi-fat, non-fat) could not be evaluated.

Since the Beck Depression Inventory is an individual self-administered scale to identify individuals with depressive symptoms, there may be inconsistencies in the results.

Individuals with a disease statement were excluded from the study. It is a study limitation because it is based on an individual statement. Also, this may have reduced the number of patients diagnosed with severe depression in our study. Finally, since our study was not an experimental study, the food consumption of individuals was not intervened. This situation prevents the establishment of a full and distinct cause-effect relationship in the correlation between food consumption and depression.

Conflict of interest
None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

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